GUIDE TO THE

THIRTY-SIXTH ANNUAL FIELD CONFERENCE

OF THE

SECTION OF GEOLOGY

OF THE

OHIO ACADEMY OF SCIENCE

April 22 & 23, 1961

****

GEOLOGY OF THE CINCINNATI REGION

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GEOLOGY OF THE CINCINNATI AREA

REGIONAL DESCRIPTION

A brief description of the topography of Cincinnati in the words of Dr. Nevin N. Fenneman, founder of the Department of Geology at the University of Cincinnati, presents the physical setting of the city.

> "A structure of nearly horizontal thin-bedded limestone and shale, reduced to an almost perfect peneplain, uplifted to about 900 feet above the sea and trenched at least 400 feet by large through-flowing streams (Ohio, Miami, and Little Miami), dissected by tributaries in dendtritic fashion almost to maturity near the major valleys but elsewhere young in the cycle following uplift; glaciated (except the southern border), without glacial erosion and with deposition sufficient to obliterate only the smallest valleys; the master streams displaced in part by the ice, taking new courses which they have since retained. The larger valleys partly filled by till and glacial outwash, which have since been in part removed" (Fenneman 1916, p. 23).

THE STRATA

The Upper Ordovician bedrock (Stop 2 and 3) in the vicinity of Cincinnati consists of essentially horizontal layers of thin limestones and shale, and occasional silty beds. The coarsely crystalline limestone is composed calcareous shells and skeletal fragments; the shale (compaction) consists of fine detrital silt and clay derived from distant shores to the east (Caster, et al., p. 15), and in addition finely comminuted particles of shell material. These richly fossiliferous rocks, noted for the detail of preservation, were deposited on an epicontinental sea floor. The stratigraphic column exposed on the route of the field conference is shown on Plate I. The bedrock geology is shown on Plate V.

THE STRUCTURE

Although appearing horizontal in outcrop, the strata are part of the broad northeast-southwest trending beveled Cincinnati arch, the axis of which lies 15 miles east of the city. Gentle undulations of the strata extending over several miles may show structural relief up to fifty feet or more. Minor faults and folds are exposed in stream beds.

GLACIAL HISTORY

The Ohio River is a composite stream whose present course past Cincinnati is the product of at least two glacial advances. A thin deeply weathered deposit of Kansan (Durrell, 1956, p. 1751) or older drift mantles the divides in southwestern Ohio and across the Ohio River in Campbell, Kenton and Boone counties, Kentucky.

In Cincinnati and to the east, Illinoian till averaging 30 feet in thickness underlies the surface. In the larger pre-Illinoian valleys (Plate II), called the Deep Stage (VerSteeg, 1934, p. 613), Illinoian sand and gravel and laminated lake clays (Stop 5) are overlain by till of the same age. Here the total accumulation of Illinoian drift reaches 280 feet.

The Wisconsin glacier, (Plate IV) stopping its major advance north of Cincinnati near Pisgah and Greenhills, Ohio (Stop 6) pushed tongues of ice (Plate II) down the larger valleys such as the valley of Mill Creek and the Great Miami valley to the northwest of the city (Stop 7). Meltwater sent floods of sand and gravel into the drainage ways causing aggradation to 540 feet in downtown Cincinnati, 560 feet at Reading and 600-620 feet at Hamilton. Since their deposition these valley train deposits have been dissected into matched and unmatched terraces (Milepost

1.9 to 4.1, 4.9 to 5.8).

DRAINAGE CHANGES

Prior to the Pleistocene Epoch the main drainage of the Cincinnati area was northwestward, as evidenced by abondoned high level valleys in Campbell, Pendleton and Harrison Counties of northern Kentucky (Desjardins, 1934, p. 16) and high level straths in Hamilton County, Ohio (Milepost 16.0 to 17.4). The major stream, the 'Teays Licking' (Plate II) meandered in a 3/4th mile wide valley incised 100-150 feet below the upland surface or Lexington (Harrisburg) peneplain (Fenneman 1938, p. 441) and 200 feet above the present drainage. Lake clays and silts, similar to the Minford silts of southcentral Ohio, accumulated in the 'Teays Licking' valley when its northward flow was blocked by a pre-Illinoian ice advance.

The initial abandonment and overflow of the finger lakes produced by the pre-Illinoian ice advance in the 'Teays Licking' and contemporary valleys initiated the Deep Stage drainage (Plate II). Because of a shorter distance westward to the Mississippi River or because of increased volume accompanying the union of several watersheds or possibly uplift, or all three conditions, the new drainage lines were incised 450 feet below the upland surface (Plate III). It is in the valley of the Deep Stage drainage (Plate II), partially filled by later glacial drift and in part abandoned by present streams, that the most important reservoirs of underground water in the Cincinnati area are located (Stop 7).

The Illinoian advance disrupted the Deep Stage drainage. Terrace remnants (Stop 5) record a period of ponding and delta building. The ponded Deep Stage Ohio and Licking overflowed across two north-south divides, one near Dayton, Kentucky and the major one near Anderson's Ferry (Fenneman, 1916, p. 116) establishing its new and present course past downtown Cincinnati and completely abandoning its old loop northward around the city (Plate III). Today the river breaches this old divide in a narrow gorge (Stop 1) with barbed tributaries.

ECONOMIC GEOLOGY

Sand (Stop 5) and gravel deposits, largely of Wisconsin age, (Plate IV), are recovered in the Little Miami, Mill Creek and Great Miami valleys. In 1959, the output of sand and gravel in Hamilton County was 3,500,000 tons. This output was valued at $4,935,010.

Excellent sources of ground water for industrial and domestic use are found in the major valleys of the Deep Stage drainage. In 1960 the city of Lockland, Ohio used about one million gallons, and the Southwestern Ohio Water Company (Stop 7), a non-profit company organized by twelve of the larger corporations in Mill Creek valley, pumped over fourteen million gallons daily.

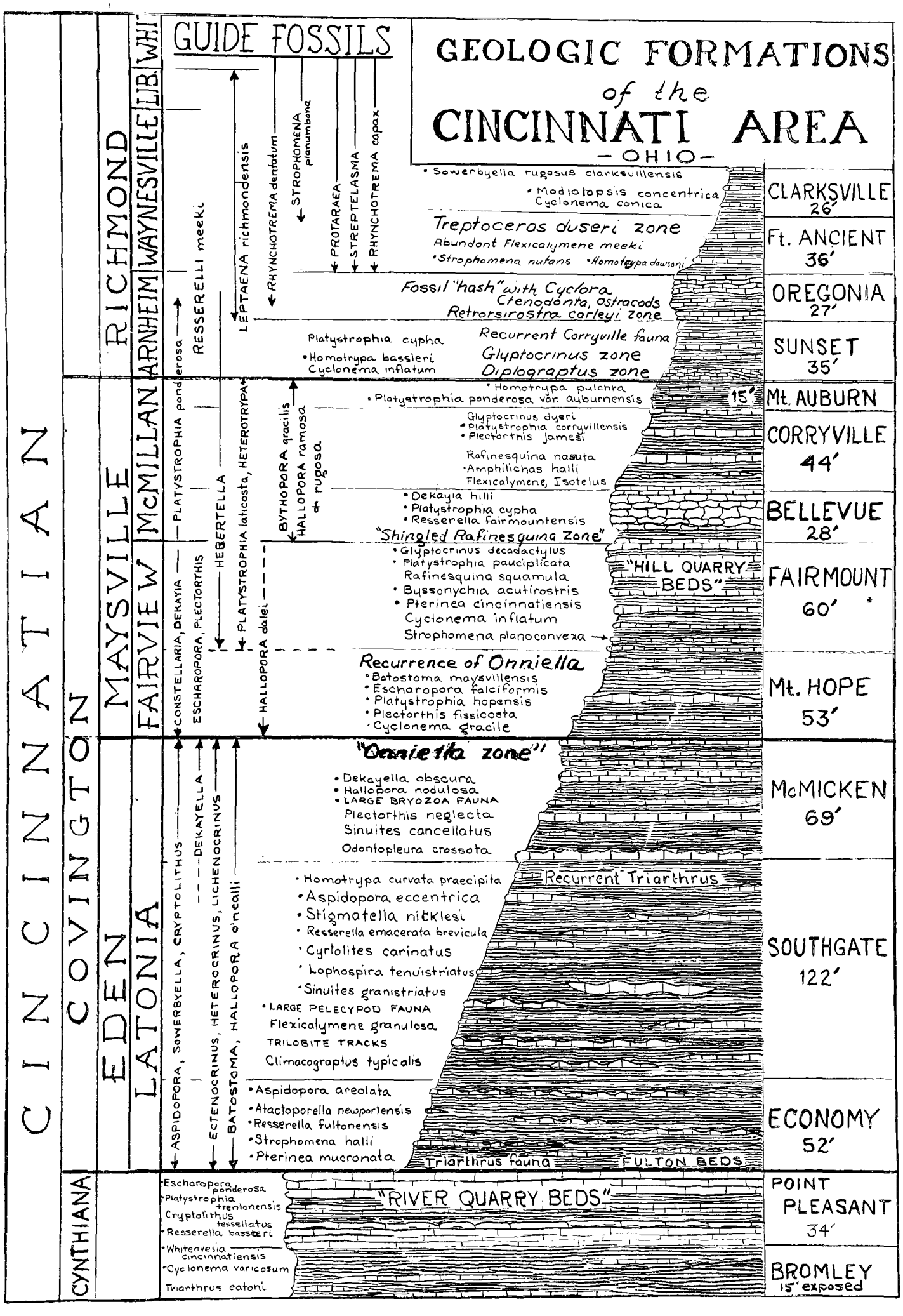
Prior to World War II brick was made from glacial clays near Rossmoyne, Ohio on the upland and river clays on the floodplain of the Ohio River. One small plant in Mill Creek valley used the Eden shale, but all these operations have come to an end.

ASSEMBLY - 7:45 A.M. in the Health Service parking area to the west of the Old Tech building. Extra guidebooks and topographic maps will be available. Box lunches will be delivered to Stop 4, Bellevue Hill Park. DEPARTURE WILL BE PROMPTLY AT 8:00 A.M.

DRIVERS - A large number of cars are expected, so please park your car in the assembly area so that as many cars as possible can be accomodated. Markers for your car will be provided. The route through Cincinnati has been planned so that the caravan will be on numbered routes most of the time. However, it will not be possible to stay in line, so please drive from stop to stop quickly and carefully.

GEOLOGIC FORMATIONS of the CINCINNATI AREA — OHIO —

PLATE I.



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FIELD CONFERENCE APRIL 22nd 1961

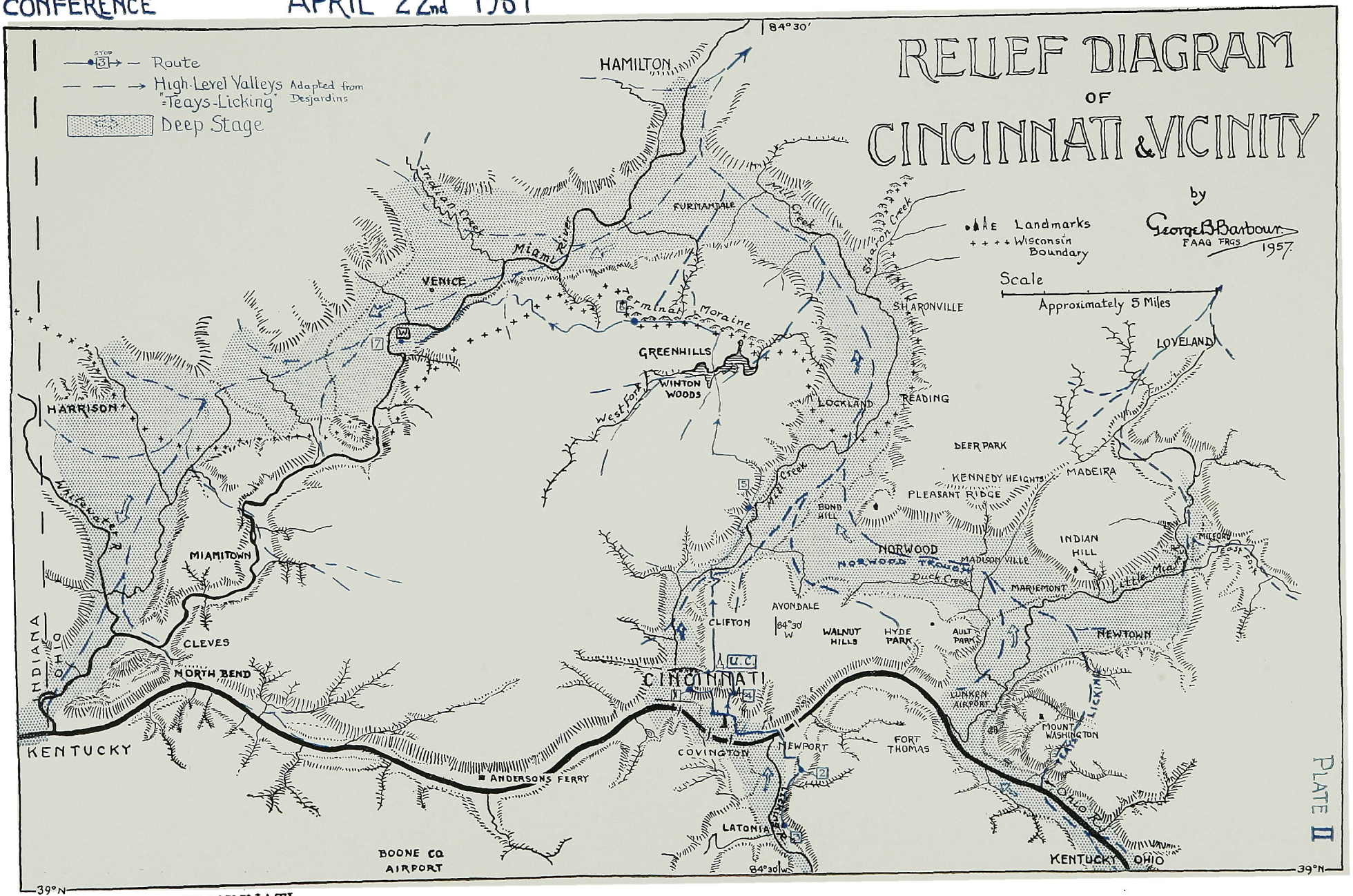
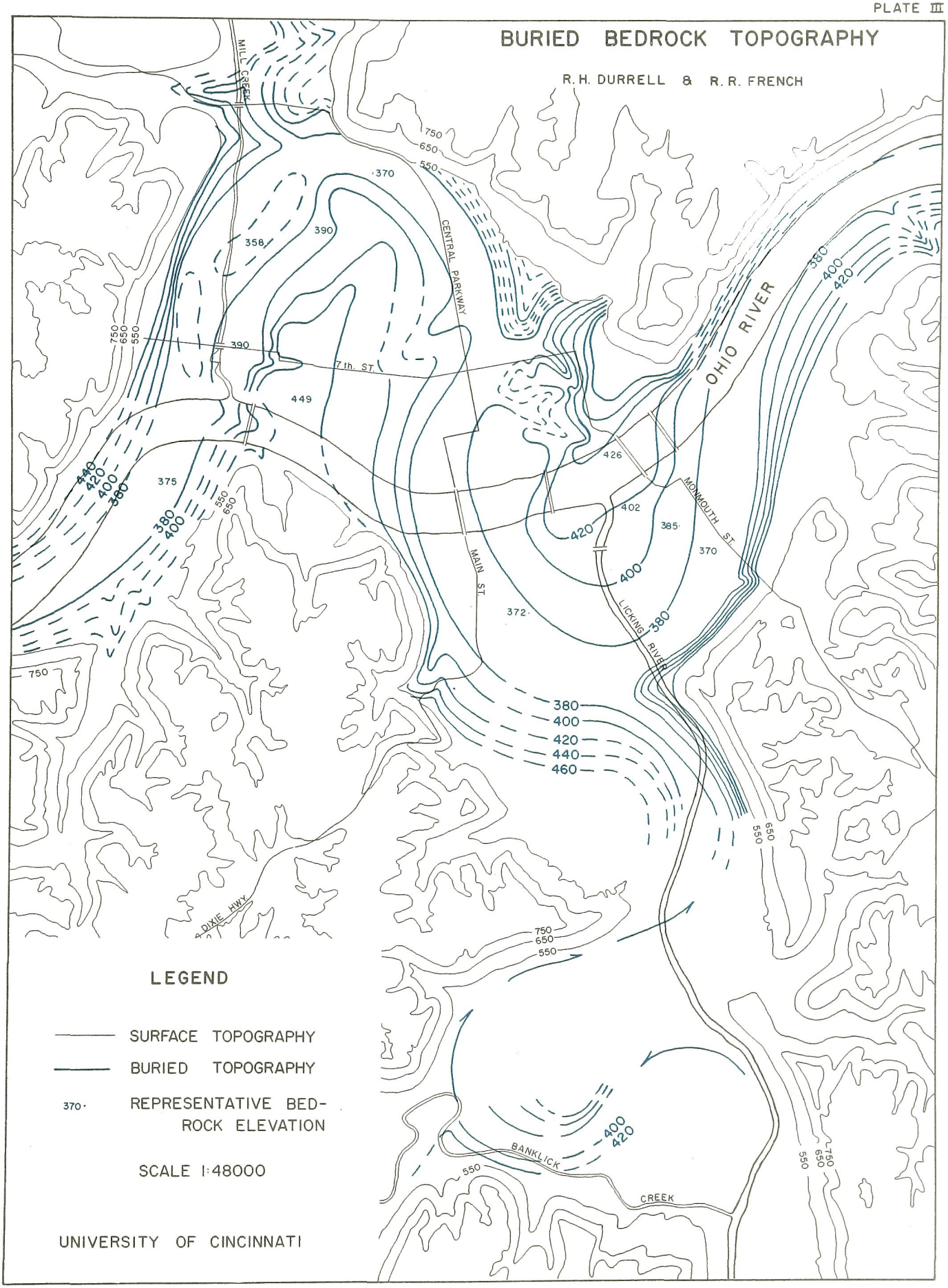


PLATE II

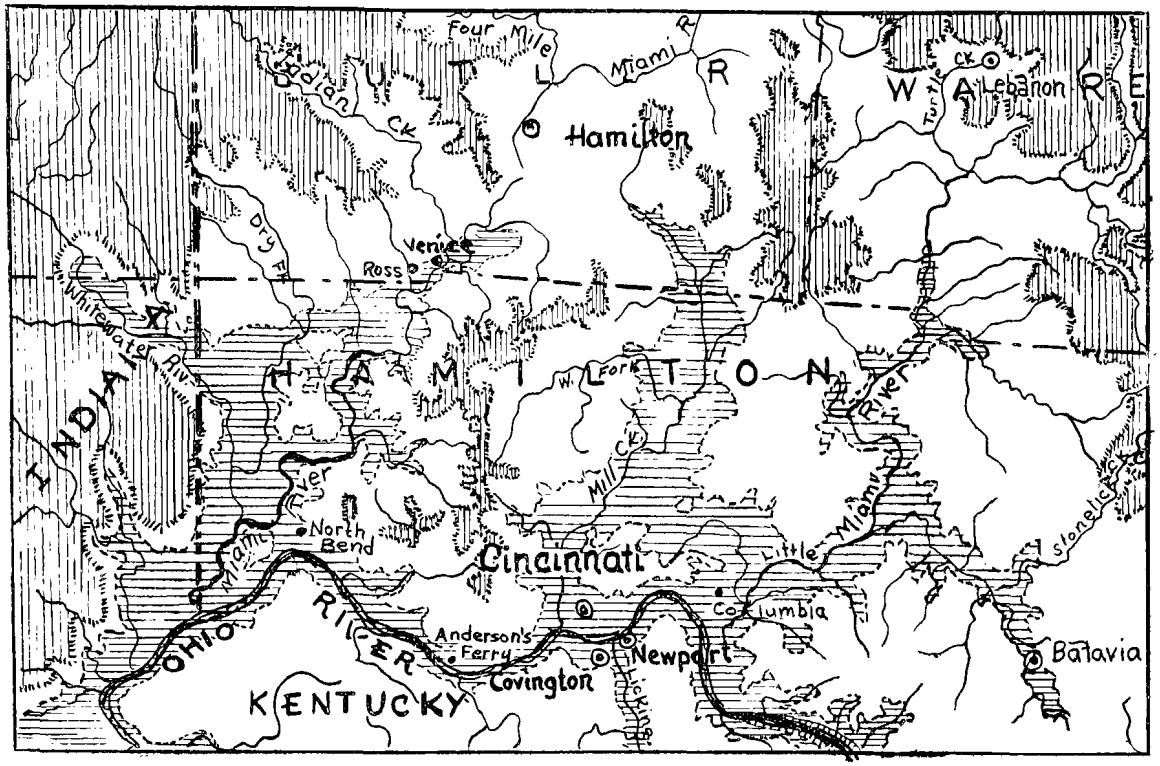
UNIVERSITY OF CINCINNATI

8 3/8 8.375


BURIED BEDROCK TOPOGRAPHY
R.H. DURRELL & R.R. FRENCH
MILL CREEK
CENTRAL PARKWAY
7th. ST.
OHIO RIVER
MONMOUTH ST.
MAIN ST.
LICKING RIVER
DIXIE HWY.
BANKLICK CREEK
LEGEND
SURFACE TOPOGRAPHY
BURIED TOPOGRAPHY
370· REPRESENTATIVE BEDROCK ELEVATION
SCALE 1:48000
UNIVERSITY OF CINCINNATI

AREAL GLACIAL MAP

PLATE IV



ORDOVICIAN

- Richmond
- Maysville
- Eden
- Cynthiana

BEDROCK GEOLOGY

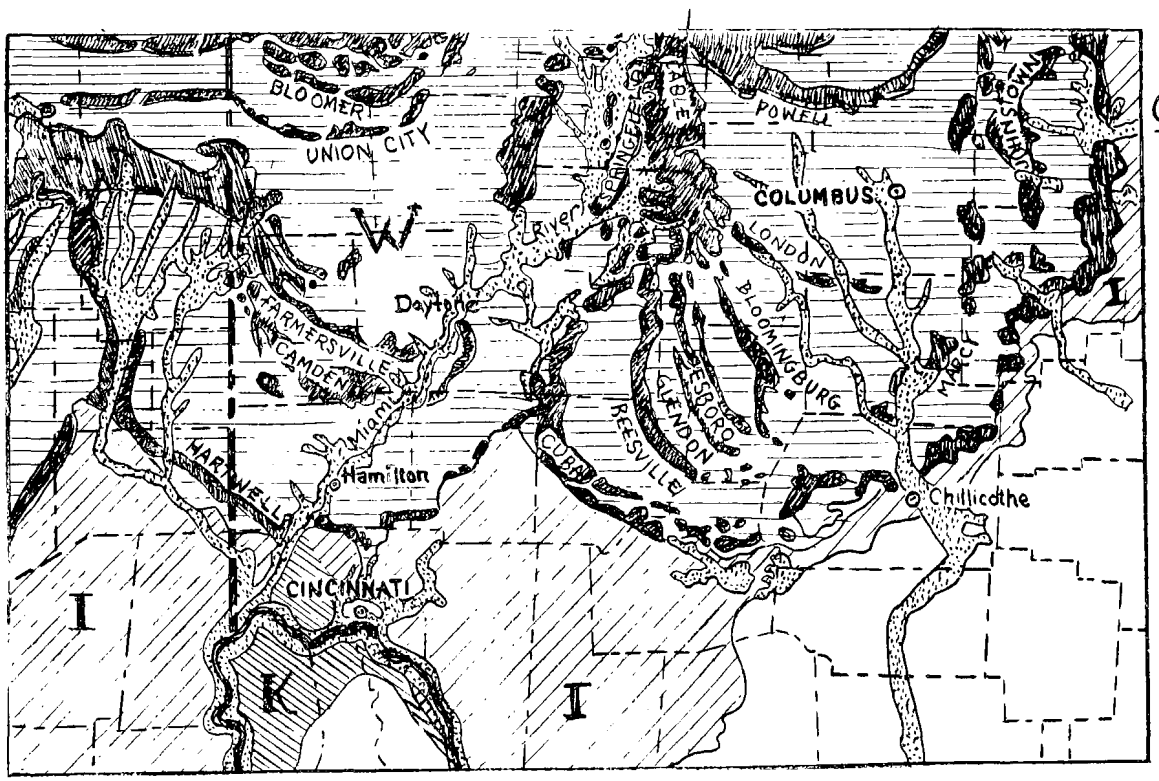
PLATE V

(From state geological maps of Ohio, Indiana, & Kentucky)

SCALE - miles

10 0 10 20

N



QUATERNARY

WISCONSIN

- end moraine
- ground moraine
- outwash

ILLINOIAN

KANSAN

UNGLACIATED

SURFICIAL GEOLOGY

PLATE VI

(From G.S.A. Glacial Map of U.S.)

SCALE - miles

25 0 25 50

ROAD LOG

MILEAGE

0.0 0.0 Health Service parking area behind McMicken Hall, University of Cincinnati. Leaving parking area cross main campus avenue, bear right down ramp to Clifton Ave...turn left (south) on Clifton taking middle or right lane after first stop light.

0.5 0.5 Turn right at traffic light and T-junction with McMillan Street. After next traffic light at "Five-point" junction continue straight down McMillan Street. Move left.

0.4 0.9 Turn left (west) into FAIRVIEW PARK SCENIC DRIVE, which follows line of "Hill Quarry" beds (Fairmount member of Fairview formation) round the hill. Bellvue limestone (Rafinesquina fracta zone) above drive on left.

0.4 1.3 STOP 1 - FAIRVIEW PARK OVERLOOK. (30 MINUTES)

From this vantage point on the floor of an old "hill quarry", typical of many of the promontories around downtown Cincinnati, the following features may be observed:

1. The even skyline (Fig. 1a & 1b) of the region at altitudes of 850-950 feet marking the remnants of the Lexington (Harrisburg) peneplain (Fenneman, 1938, p. 441).
2. To the south-southeast foreground the broad relatively undissected Wisconsin outwash terrace (540') on which downtown Cincinnati is built. This terrace afforded a site above floods for the construction of Fort Washington in 1789 during the Indian days.

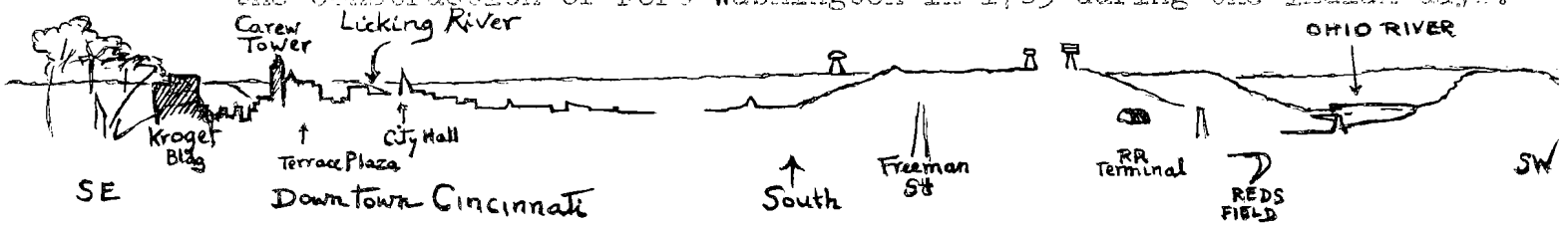


Figure 1a

The superior location above high water gave Cincinnati the advantage over Columbia to the east and North Bend to the west. Both remain today as small communities up and down river.

3. The floodplain of the Ohio River and Mill Creek at 480-490 feet altitude. A barrier dam costing $11,146,000. was built in 1948 to prevent the floodwater of the Ohio River from backing up into the industrial Mill Creek valley and at the same time accomodate Mill Creek drainage.
4. To the southwest in the distance the narrow, youthful, post-Illinoian valley of the Ohio River formed when the ponded Deep Stage Drainage overflowed a low point in the divide three miles farther west at Anderson's Ferry (Plate II).
5. Immediately west and below the overlook, the relatively wide pre-Illinoian valley of Mill Creek formerly occupied by the North flowing Deep Stage tributary, the Licking. Plate III shows the bedrock topography of the basin of Cincinnati (Durrell, 1961) and the channel of the Deep Stage Licking crossing from south to north at 380 feet altitude, and the ingrown course at 360-370' of the post Deep Stage Ohio.
6. To the west across Mill Creek valley, Bald Knob, a 1930 borrow area for fill to raise the level of the floodplain of Mill Creek

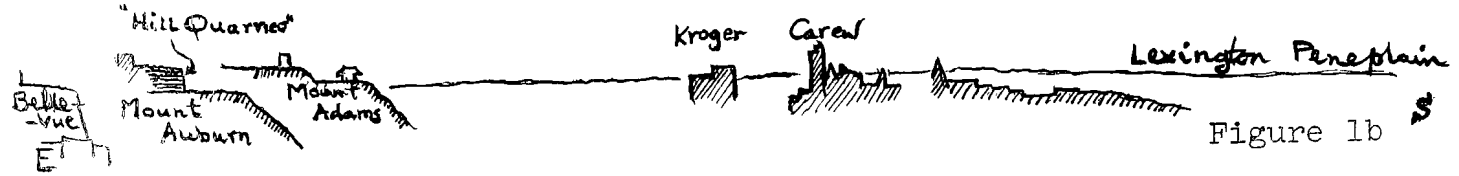


Figure 1b

for the Cincinnati Union Railroad Terminal. The top of the knob exposes the limestones and shales of the Fairmount and Bellevue members of the Fairview and McMillan formations respectively.

0.2	1.5	Look left over playground. Outcrops of Bellevue underlying Corryville. (See Fig.1b) Wall on right built of Hill quarry ls..
0.1	1.6	Stop. Turn right down Ravine Street. In one tenth mile talus on right partially hides Mt. Hope member of the Fairview formation.
0.2	1.8	Stop. Continue across McMicken Street. McMicken member of Eden group got its name from outcrops along this street.
0.1	1.9	Stop. CAUTION crossing traffic to turn left (south) on Central Parkway - U.S. 27. For the next two miles the Central Parkway follows the route of the abandoned Cincinnati-Lake Erie Canal at the level of the Wisconsin outwash terrace (540').
0.9	2.8	Note Music Hall left, home of the Cincinnati Symphony Orchestra. (Move into left two lanes.)
0.1	2.9	Turn left (east)on Central Parkway - U.S. 27.
0.4	3.3	Note Kroger Building right. Crossbedding exposed in foundation excavation ranged from due west to northwest, agreeing with similar measurements in the basin and indicating that the outwash filling the area came down the Ohio.
0.2	3.5	Turn right (south) on Sycamore Street - U.S. 27 - round the Hamilton County Courthouse.
0.6	4.1	Fourth Street. Continue South off Wisconsin terrace to Third Street. In 1937 flood, coastguard cutters cruised up and down Third Street.
0.1	4.2	Turn left (east) on Third Street - U.S. 27 - paralleling the Third Street Distributary.
0.05	4.25	Turn right (south) on Broadway - U.S. 27 - and descend to floodplain of the Ohio River (490'). Plaque on modern garage at Third and Broadway commemorates the site of Fort Washington which was located two blocks to the east.
0.1	4.35	Traffic light at Second Street. Bear left up ramp of Broadway Bridge - U.S. 27. Height of 1937 flood reached the window sills of the second story, January 26th.
0.25	4.5	Enter Kentucky. Ohio River flows entirely in the state of Kentucky. Note mouth of Licking to right with its heavier sediment load. The older houses of Covington on the Wisconsin terrace (510') west of the Licking River and the floodwall of Newport visible to the right and left ahead.

0.4 4.9 Traffic Light...turn half-right leaving ramp to enter York Street U.S. 27. Driving south climb up onto partially dissected Wisconsin terrace which here and especially to the south is underlain by salts and lake clays deposited at the time of the aggradation of the Ohio channel.

0.3 5.2 Note Wiedeman Brewery (510') to right. A deep well penetrated bedrock at 364' here in a post Deep Stage Ohio meander.

0.5 5.7 Traffic light. Turn left (east) on East 11th Street - U.S. 27.

0.1 5.8 Traffic light. Turn right (south) on Monmouth Street - U.S. 27 - under L. & N. and C. & O. Railroad bridges. Stay in left lane along side of shopping center.

0.4 6.2 [redacted]ght. Turn left into Newport Shopping Center, then bear right (south).

0.1 6.3 STOP 2 - NEWPORT SHOPPING CENTER - THE EDEN GROUP. (40 MINUTES) (Park at southwestern end of parking area to the right of Western Auto). (580')

Eden Group. The Eden Group is faunally divided into three members, the upper two being well exposed in this cut excavated for the Newport Shopping Center.

Fossil List (Fig. 2).

Aspidopora newberryi	Batostoma jamesi
Sowerbyella rugosus	Hallopora oneilli
Cryptolithus tessalatus	(Trilobite tracks are common)

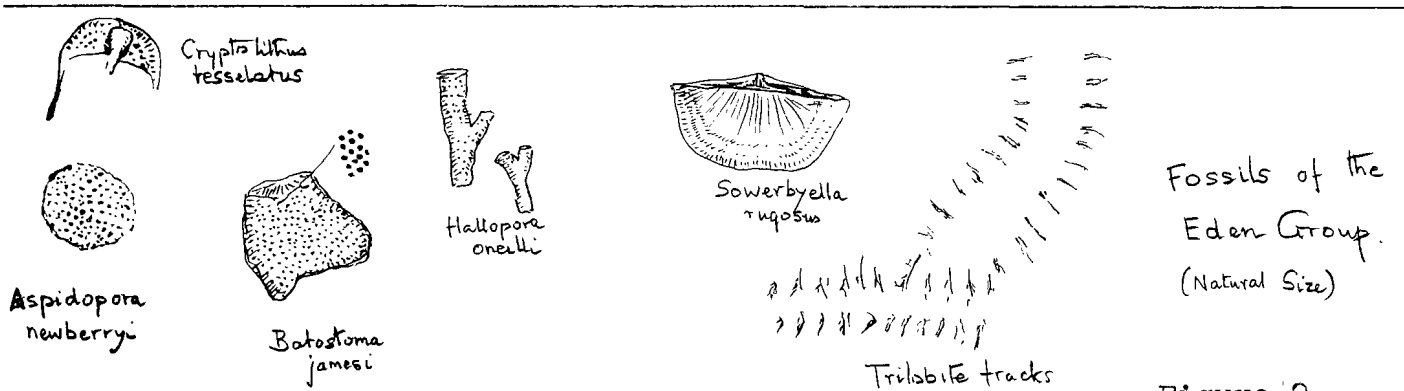


Figure 2

McMicken [redacted]. The upper 70-foot cliff exposes a complete section of oxidized and partially weathered McMicken member of the Eden Group. The strata consists of blue-gray shales and limestones, the latter composing 20% by volume. The limestone beds in the McMicken are thicker than in the other members of the Eden. A thick limestone with pararipples (Bucher, 1919, p. 259) commonly marks the top of this unit.

The partially grassed-over uppermost slope is underlain by deeply weathered Fairmount beds containing 10-14" limestones with typical fossils. Deeply weathered silts (?) cap the ridge.

Reworked Eden pebbles with crinoid bases are a novelty in this cut.

Fossil List (*indicates restricted index fossils)

*Dekayella obscura	Sinuites cancellatus
*Hallopora nodulosa	Odontopleura crossota
Plectorthis neglecta	*Large bryozoa fauna
Onneilla emacerata (top)	

Southgate Member. The remainder of the exposure is composed of the less weathered blue-gray shales and occasional thin, somewhat discontinuous limestones of the Southgate member.

Fossil List (*indicates restricted index fossils)

*Homotrypa curvata praecipita	*Lophospira tenuistriatus
*Aspidopora eccentrica	*Sinuites granistriatus
*Stigmatella nicklesi	*Large pelecypod fauna
*Onniella emacerata brevicula	Flexicalymene granulosa
*Cyrtolites carinatus	Climacograptus typicalis

Landslides. The Eden shales underlying the lower slopes in the Cincinnati area are frequently involved in the major landslides of the region. Most commonly, the mantle slides over the moist, slippery shales. In 1958, four new homes in the next valley to the south were completely destroyed by landsliding and several others were damaged.

0.1	6.4	Leave shopping center by "Sohio" exit. Turn left (south) on Alexandria Pike - U.S. 27.
0.3	6.7	Leave Newport, Kentucky.
0.2	6.9	Exposure of Eden Group left behind Model Laundry.
0.2	7.1	Right (west) beyond Dinner Bell Tavern exposure in deeply weathered though level valley fill (685') correlated with pre-glacial drainage.
0.1	7.2	St. Theresa Church and School on high level strath (690') correlated with "Teays" Licking drainage.
0.1	7.3	Traffic Light at Highland Avenue. Continue straight (south) on U.S. 27.
0.3	7.6	High cliff right exposing conspicuous Eden-Maysville contact.
0.2	7.8	High cliff left exposing conspicuous Eden-Maysville contact.
0.3	8.1	STOP 3 - ALEXANDRIA PIKE (opposite entrance to Beverly Hills Club) - MT. HOPE-FAIRMOUNT MEMBERS, FAIRVIEW FM., MAYSVILLE GROUP (40 minutes)

A. The massive limestone beds of the upper McMicken member floors this quarry. The lower cliff is lithologically typical of the Mt. Hope member. The upper cliff in the trees (an old "hill quarry") exposes strata of the more massive Fairmount member.

B. The quarry to the north, also opened for "field stone" and fill, exposes the contact between the Eden and the Maysville and shows the markedly different lithographic character of each.

Fossil List - Mt. Hope Member (*indicates restricted index fossils)(Fig.3a)

*Batostoma maysvillensis	*Plectorthis hopensis
*Escharopora falciformis	*Cyclonema gracile
*Platystrophia hopensis	Constellaria florida

Fossil List - Fairmount Member (*indicates restricted index fossil)(Fig.3b)

*Glyptocrinus decadactylus	*Pterina cincinnatiensis
*Platystrophia pauciplicata	*Cyclonema inflatum
Rafinesquina squamula	Strophomena planoconvexa
*Byssonychia acutirostris	Hebertella sinuata
Constellaria florida	Platystrophia laticosta

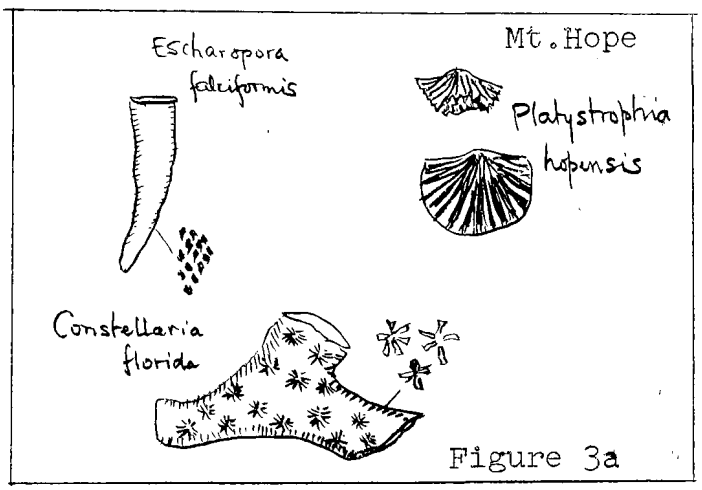


Figure 3a

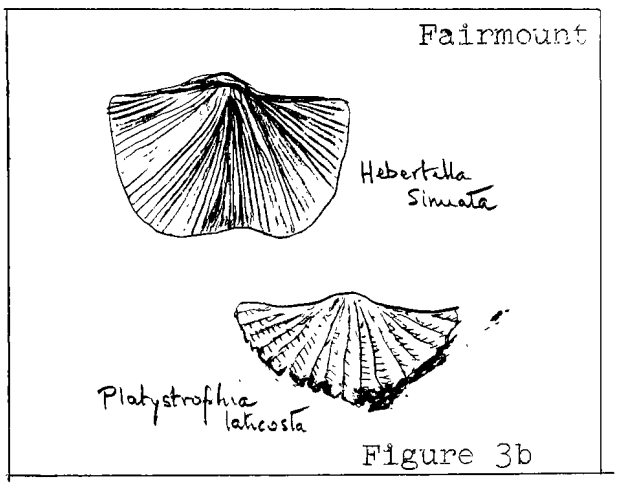


Figure 3b

0.0	8.1	Retrace route right (north) on Alexandria Pike - U.S. 27.
1.8	9.9	Traffic light - Continue straight past Newport Shopping Center.
0.5	10.4	Traffic light beyond underpass. Continue north across E. Tenth Street on Monmouth - U.S. 27.
0.25	10.8	State Theater (left) and Hippodrome Theater (right) (510') A deep well penetrated coarse gravel at 147' depth. These gravels are commonly found a few feet above bedrock.
0.3	11.1	E. Fourth Street. Descend straight ahead to floodplain. Newport floodwall ahead.
0.1	11.2	Turn left (west) on E. Third Street - U.S. 27.
0.1	11.3	Traffic light. Half right onto ramp of bridge - U.S. 27.
0.2	11.5	Crest of bridge. Cincinnati public landing to left, older buildings on floodplain (485') and large office buildings on Wisconsin terrace (540'). More traffic in barges pass under this bridge than pass through the Suez and Panama canals combined. In 1960, 81 million tons of shipping moved by Cincinnati.
0.2	11.7	WELCOME BACK TO OHIO!
0.2	11.9	[illegible]ve point traffic light. Half right up Broadway Avenue - U.S. 27. Fort Washington plaque on right.
0.1	12.0	Note (right) Academy of Medicine building constructed of Buena Vista stone (Waverly). Many of the older buildings in the city

were constructed of this stone popular at the turn of the century. Its popularity was partly based on cheap barge transportation downstream.

0.4 12.4 Left (west) on E. Ninth Street - U.S. 27 - for two blocks.

0.2 12.6 Turn right (north) on Main Street - U.S. 27.

0.2 12.8 Turn left (west) on Central Parkway - U.S. 27 - for two blocks - Move right.

0.1 12.9 Traffic light. Right (north) on Vine Street leaving U.S. 27 (Kroger Building left). Enter "Uber den Rhein" district originally heavily populated by German immigrants.

0.7 13.6 Five point traffic light. Continue straight across East McMicken Street. Move into left lane.

0.1 13.7 Traffic light. Turn half left (west) up Clifton Avenue.

0.1 13.8 Note inclined attitude of last house on left. There are many such examples in the Cincinnati area of accelerated creep of mantle on the Eden shales.
Note (right) exposures of McMicken member of Eden Group.

0.1 13.9 Abandoned foundation (right) of Incline Railway for transport of street cars to hilltop suburbs. Lunch stop is directly above this point. Eden-Maysville contact just beyond this point.

0.1 14.0 Turn right. Massive beds of Mt. Hope member at right with continuous section up to projecting Bellevue limestone at top. This is type section for Bellevue limestone.

0.2 14.2 Turn right (east) at Sohio service station off Clifton Avenue onto Parker Avenue (BELLEVUE HILL PARK Sign).

0.1 14.3 Top of hill. Turn right (south) on Ohio Avenue.

0.1 14.4 STOP 4 - BELLEVUE HILL PARK - LUNCH STOP (Box lunches and drinks will be available at the shelter house. Rest facilities inside at rear. Picnic tables beyond parking area to east). (45 minutes).

This was formerly the site of the power house of the incline railway seen a few moments ago. At one time there were four inclines operating to all the larger hilltop suburbs.

The panorama from Bellevue Hill, although similar to Fairview Park (Stop 1), provides an opportunity to see one of the abandoned hill quarries to the southeast and to give a better idea of the eveness of the skyline (Fig. 1a & 1b). Great care should be taken if one climbs down the west side to view the Bellevue limestone.

0.1 14.5 Return to Ohio Avenue. Turn left (north).

0.5 15.0 Traffic light. McMillan Street. Continue straight.

0.1 15.1 Stop. Turn left (west) at "T" end on Calhoun Street.

0.1 15.2 University of Cincinnati Campus right. Surface drainage from this point is northward.

0.2 15.4 Traffic light at "T" junction with Clifton. Turn right.

0.4 15.8 Burnet Woods right (92 acre park).

0.2 16.0 Hebrew Union College (Jewish Reform) left. Descend to gently rolling strath (680-720') correlated with the high level valleys of northern Kentucky (Desjardins 1934, p. 16)(Plate II). Route follows strath for one mile.

0.4 16.4 Traffic light. Continue across Ludlow Avenue on Clifton. Move in left lane at next three traffic lights.

1.0 17.4 Slow. Descend from 710' by steep winding road.

0.2 17.6 Sharp curve left. Dissected Illinoian terrace visible right and left (620').

0.25 17.85 Under Mill Creek Expressway. Excavation for footings exposed till-lake clay contact (545') 5 feet below expressway level.

Landslides - The Mill Creek Expressway follows for several miles the edge of the Illinoian Terrace of till underlain by lake clays and silt. As a result, landslides have been common. The remedial measures for the largest slide cost over $425,000. The large amount was in part the result of a lack of appreciation of the geologic setting and the behavior of the earth materials involved.

0.05 17.9 Bridge over Mill Creek. This south flowing misfit stream occupies the wide valley of the former north flowing Deep Stage Licking.

0.2 18.1 Traffic light. Turn right (north) after crossing B & O RR at Winton Place station on Spring Grove Avenue - Ohio 4W.

0.05 18.15 Main office of Cincinnati Water Works at left. Artificial concentration of erratics (500').

0.45 18.6 Cross B & O RR single-track spurline. Move into left lane.

0.2 18.8 Traffic light. Turn left (west) on Este Avenue (Bonded Service Station). Ivorydale plant of P & G ahead.

0.2 19.0 Cross B & O RR multi-track freight line. Well here reached bedrock at 415'.

0.1 19.1 Turn right (north) on Este Avenue (Sohio Service Station). Illinoian terrace left.

0.6 19.7 STOP 5 - GEORGE L. RACK SAND AND GRAVEL COMPANY (510'). (50 Minutes). Admission by courtesy of owner and Mr. M. E. Deiters. The company assumes no responsibility for injury - BE CAREFUL! (Park off Este Avenue near company office. Assemble at scales).

A. VISIT TO PIT.

This pit in the filling (Fig. 5a) of the Deep Stage Licking River valley affords one of the few localities where Illinoian

stratigraphy can be examined. Continued study of the working faces cut into this terrace (600') has shown two advances of Illinoian ice (Fig. 5c). The lack of weathering at the top of the lower till indicates only a short interval of time, thus it represents a pulsation rather than an interstadial interval.

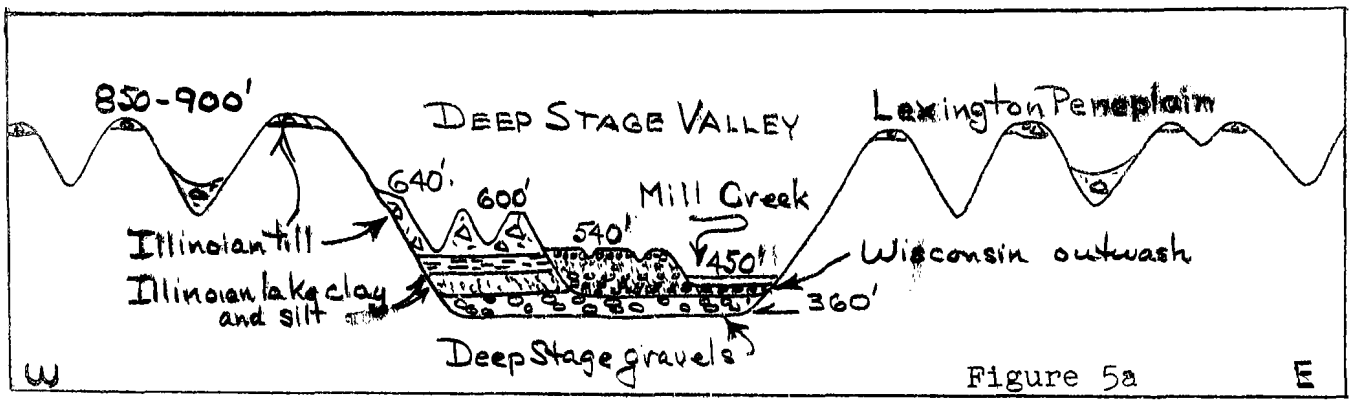


Figure 5a

Deformation and thrusting in the till indicate ice movement from the northeast. Figure 5b, sketched here in 1957, shows thrusting similar to that found 2 miles to the south on the opposite side of the valley in cuts made for the Mill Creek Expressway. Till-fabric studies, striations, till fluting and lobation of depositional forms in the area to the northeast indicate a similar direction of Illinoian ice movement.

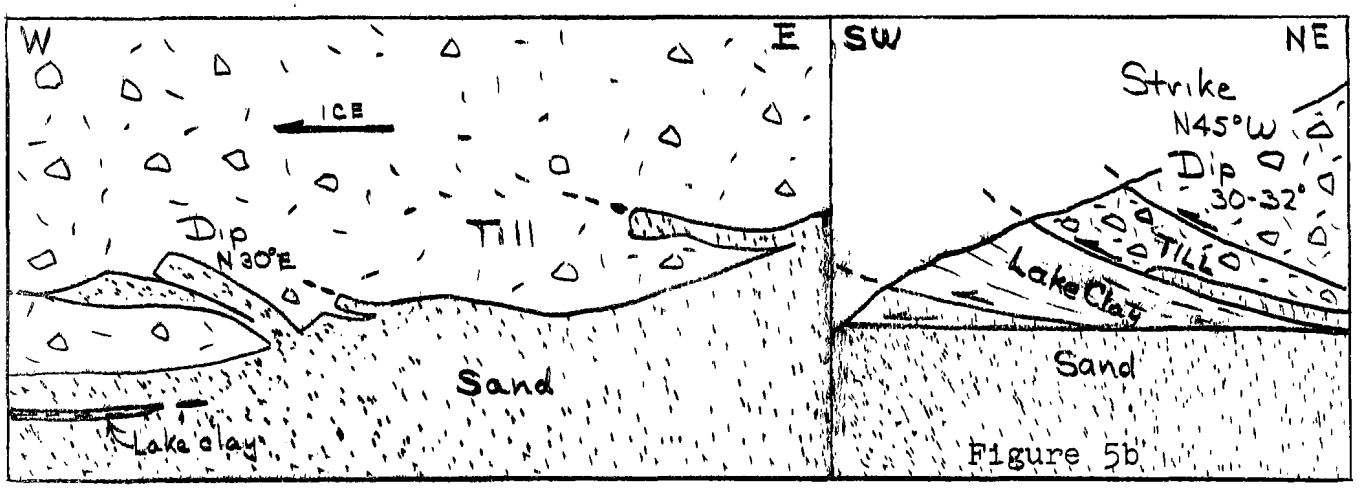


Figure 5b

Pits 60 feet deep in this excavation have shown nothing but sand. However, nearby water wells (Fig. 5c) in the valley indicate the base of the sand to be at 380 feet in altitude, 130 feet below the level of the weighing scales.

Study of the numerous sections in Mill Creek valley suggest a number of sand deltas constructed in the ponded meltwaters in front of the Illinoian glacier. This accounts for the close association of inclined delta sands and rhythmites. In the general latitude of this stop and Winton Place-Carthage the rhythmites of fine sand, silt and lake clay grade southward toward the Ohio into thicker laminated clays considered to be varves.

The following products are sold by George Rack: sand, masonry sand, sub-basement sand, ball diamond clay and top soil. In 1960, 200,000 tons of sand were produced.

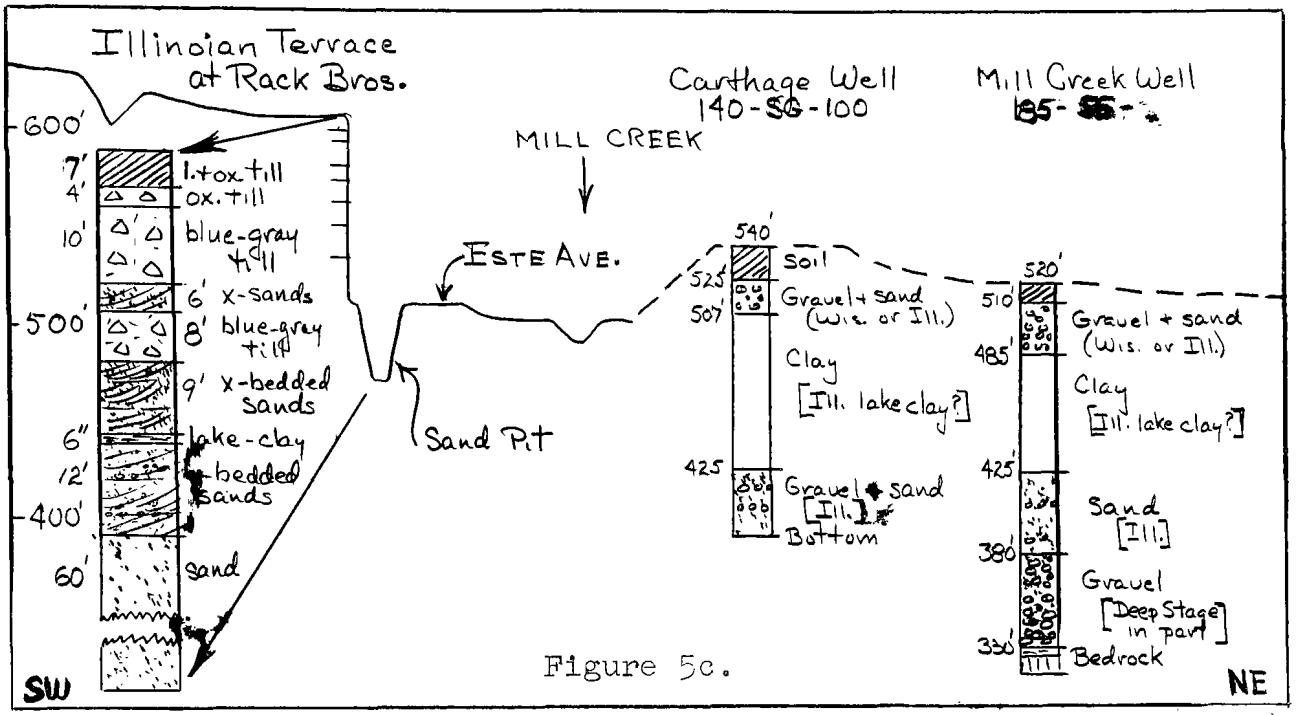


Figure 5c.

B. TOP OF TERRACE. Over 40 large industries, a few of which can be seen here, occupy most of the valley of Mill Creek. These and several small communities draw much of their water supplies from the deeper gravelly sands, either alluvial gravels of the Deep Stage Licking or Illinoian outwash. From about 1895 to 1948 the water table at Ivorydale, to be seen to the right, dropped from 37 feet below the surface to 130 feet (Bernhagen and Schaefer, 1946, p. 27)(Schmidt, 1959). Following the development of the Southwestern Ohio Water Company (Stop 7) in the spring of 1951, which pipes well water from the Great Miami River valley approximately 15 miles eastward to thirteen industries in Mill Creek valley, the water table has risen to less than 85' below the surface at Ivorydale.

Eastward from this vantage point (600') across Mill Creek valley can be seen the transverse profile of the Deep Stage Ohio River between the southern bluff at Avondale on the south and its northern bluff at the silver water tower in north Norwood. Eastward from Norwood the flat Illinoian filling (640') is utilized by an extensive industrial complex. The abandoned valley is called the Norwood Trough (Plate II).

0.0 19.7 Leaving George Rack Company turn left (north) on Este Avenue.

0.6 20.3 Stop. Turn left (west) on Center Hill Avenue. Road climbs through dissected Illinoian terrace (610-640') and then climbs to upland level.

0.8 21.1 Left, site of University of Cincinnati Nuclear Research Center.

0.1 21.2 Winton Hill Technical Center, P & G Co. right. Good view to the rear of Norwood Trough and Deep Stage Licking and Ohio valleys.

0.8 21.9 Stop. Turn half left (west) on North Bend Road.

0.15 22.05 Traffic light. Right (north) on Winton Road. Route for next three miles traverses gently rolling, northward draining Illinoian till plain (870-890').

3.35	25.4	McKelvey Road. (Shroyer Nursery office left) View ahead of higher land of Wisconsin terminal morraine. Elevations of 750-770 feet are common in this area are correlated with straths in Clifton (milepost 16.0 to 17.4) and high level valleys in northern Kentucky (Desjardins, 1934).
0.5	25.9	Enter Winton Woods Park (1985 acres). Illinoian till leached 6-8' in this cut, typical of area traversed.
0.2	26.1	Cross bridge over Winton Lake (675') formed by damming the West Fork of Mill Creek. This is essentially a flood control project constructed by the Corps of Engineers in 1952 at a cost of $3,538,000.
0.4	26.5	Enter Greenhills, a by-product of the depression of 1930. The Resettlement Administration set up in 1935 built this "greenbelt" town. Completed in April 1938, it cost $11,508,001 and consisted of 185 residential apartments and 24 single houses. It is now owned by the residents, having been bought by them from the government in 1948 for $3,511,300.
1.0	27.5	Traffic light...at Damon Road.
0.1	27.6	Stop. Cross West Sharon Road. Road cuts and borings showed 6-8' of leaching, thus Illinoian in age.
0.45	28.05	Within next quarter mile cross into the Wisconsin moraine (900') as shown by borings (3-1/2' leaching)(Breene 1957, p. 137) Route turns west at water tower along Wisconsin terminal moriane with a view south (left) over lower area of Illinoian mantled pre-Pleistocene strath.
0.1	28.15	Stop. Continue straight on By-pass U.S. 50. (901').
0.05	28.2	Right, good view northward of Deep Stage valley and City of Hamilton, Ohio.
0.7	28.9	Road bends left. View ahead of long profile of drumlin-like form on horizon to west.
1.9	30.8	Traffic light. Cross U.S. 127 - Hamilton Avenue.
0.5	31.3	Intersection with Pippin Road. Continue straight past head of drumlin.
0.2	31.5	STOP 6 - WISCONSIN TERMINAL MORAINE. (20 MINUTES) (Park cars well off highway. Assemble north of road).

Our route along the upland from Greenhills has traversed the hummocky topography of the terminal moraine of the Miami lobe of the Wisconsin ice. In contrast, at this stop the morainic form is not as easily discernible because of deposition on an irregular erosional surface. However, detailed soil studies and the difference in the depth of leaching has delineated the boundary. (Plate IV).

This moraine was deposited by the Late Wisconsin advance and is a continuation of the Hartwell moraine east of Mill Creek valley (Plate VI). Carbon-14 dating (W-304) at West Chester, Ohio records 19,500 B.P.. This correlates with the Cuba Moraine of the Scioto lobe to the east in Warren and Clinton counties, although the later apparently made a minor advance

1000 years later (Goldthwait, 1959, p. 199). The Wisconsin boundary marks a division of farm values. Land on the Wisconsin deposits is almost double in value that on comparable Illinoian terrain.

0.8	32.3	Note (left) sand and gravel pits of Bank Lick Gravel Co. This is a small operation in outwash and ponded alluvium marginal to the Wisconsin ice. (Plate IV).
0.2	32.5	Kame-like hill of gravel to the right.
1.8	34.3	Stop. Turn right (north) on Colerain Road - U.S. 27. (857').
0.1	34.4	Distant view left (west) down into Deep Stage valley. Note lower level of upland to the west around 800 feet. Distant view right (northeast) down to Deep Stage and city of Hamilton, Ohio.
0.7	35.1	Sharp bend to left. View ahead of Wisconsin outwash partially burying hills of drift bedrock and Illinoian.
0.4	35.7	Spring left. Wisconsin outwash terrace right (620').
0.1	35.8	Wisconsin outwash terrace left (600').
0.4	36.2	Caution! Do not cross Miami River Bridge. Continue straight on unnumbered East Miami River Road past Miami Valley Lab of P. & G. Note (right) stream gauge at left end of bridge.
0.4	36.6	East Miami River Road on floodplain of Great Miami River (550'). View left of Wisconsin terrace (610') and higher more dissected Illinoian terrace (680').
0.2	36.8	Note small alluvial fan left. Cross Texas Gas pipeline.
0.1	36.9	Note several (left) large erratics near apex of fan.
0.1	37.0	Sharp bend right.
0.1	37.1	Enter gray wire gate of Southwestern Ohio Water Co.
0.05	37.15	Descend minor unmatched terraces of floodplain of Great Miami River (520-47').
0.45	37.6	STOP 7 - SOUTHWESTERN OHIO WATER COMPANY - COLLECTOR WELL 1. Mr. Robert C. Lewis, Asst. Secretary and Asst. Treasurer of the company and a liscensed civil engineer will be our leader. (Due to the expected size of the conference party our group will be divided into two parts after the first briefing by Mr. Lewis). (60 MINUTES).

History.

Because of the falling water table, together with increased industrial and municipal consumption of ground water in the Mill Creek valley and the impetus of the World War II effort, twelve corporations in Mill Creek valley formed this non-profit company in 1949. It was actually the result of the efforts of a great many people over a long period of time starting

in the thirties and culminating in the start of construction in April 1951 and its completion in May 1952.

Southwestern is an independent effort to meet the growing national problem of metropolitan water shortages andis a tribute to the participating industries, which have a wide diversity of interests and problems, yet have cooperated in securing a greatly needed supply of industrial water. Construction and operation of this system is financed entirely by the industries without cost to any municipality or taxpayer.

The Water System.

1. Collector Well #1, located on the floodplain of the Great Miami River within the "big bend" on the east side. A reinforced concrete caisson 20 feet in diameter was sunk 137 feet to bedrock. From this caisson were projected horizontally 2,800 lineal feet of 8 inch diameter slotted collector pipe in two tiers, the deeper of which was 124 feet below grade (elevation 533 feet) and the shallower, 100 feet below grade. The estimated capacity of the collector is 16 million gallons per day. Fig. 7 shows a cross-section of this Ranney-type collector.
2. Pumping Station. Over the collector well was constructed a masonry and reinforced concrete pumping station. Five pumps have been installed in this pumping station. A second pumping station over Collector Well #2 to the northwest has three pumps with a combined capacity of 16.5 m.g.d. with a combined output of 23.7 million gallons per day at a head of 550 feet. From the pumping station, water is pumped into the main supply main through a header whose elevation is 533 feet in altitude.
3. Supply Main. Water is pumped through the supply main from the pumping station, to the reservoir at Lincoln Heights in Mill Creek valley, a distance of 13.2 miles. The maximum design capacity of the supply main is 30 MGD. The pipe is 36 inches in diameter for 39,477 feet and 30 inches for 29,924 feet. From the summit of the supply main on the divide (940') 100 feet west of Colerain Road - U.S. 27 - water flows by gravity to the reservoir, crossing two major stream valleys. Because of the mature topography, it was necessary to install at critical points along the supply main 95 vacuum-breaker and air relief valves, an unusually large concentration of such valves. From the 13,500,000 gallon reservoir in Lincoln Heights (615') water is conducted by gravity to the participating industries both to the north and south.

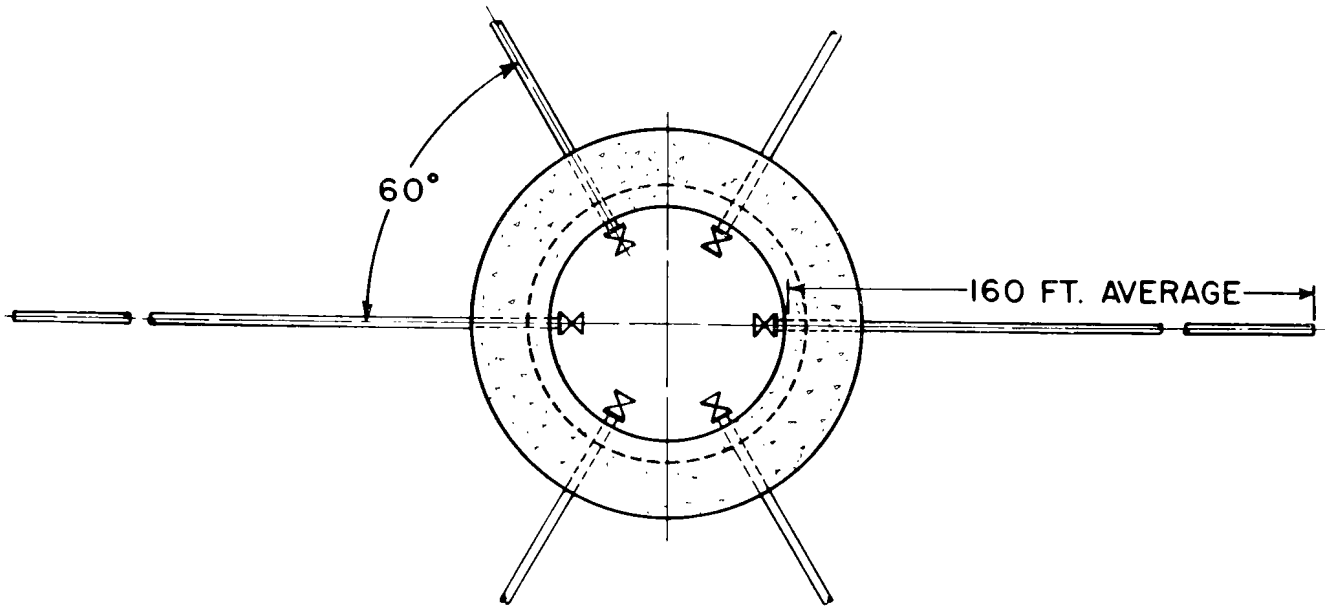
Geologic Setting.

Collector Well #1, built on the east side of the river within the "big bend", and Collector Well #2, situated one third mile to the north on the opposite bank of the river, are located approximately in the center of the Deep Stage (Ohio River) valley. Test wells show the bedrock floor to slope from 428' near the southeast bluff one half mile distant, to 365' above sea level just north of Collector Well #2, one half mile distant. Northwestward from that point the bedrock floor is not far from 365-370 feet.

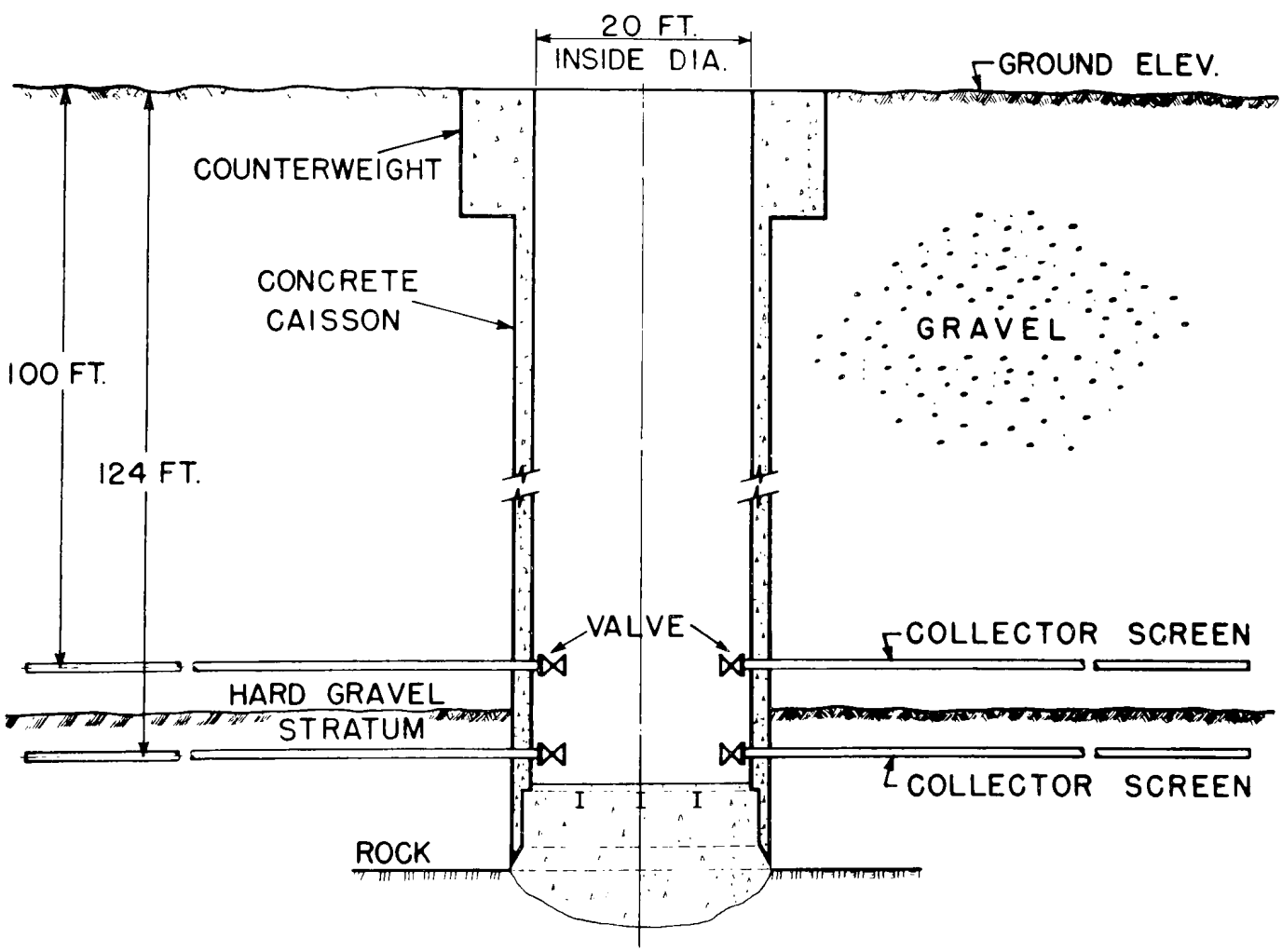
The aquifer of sand and gravel at Collector Well #1 has a nine foot impermeable silty clay layer at approximately 100 foot depth which divides the water-producing strata and accounts for the slight differences in water behavior. This impermeable layer is present in all the wells of the Fernald Atomic Energy Commission's Plant 1-1/2 miles to the west.

At Collector Well #2, this clay barrier is absent, the bedrock floor being lower and the gravel coarser. This results in a much larger flow

Figure 7



TOP VIEW OF WELL



VERTICAL SECTION THROUGH CAISSON

of water from the aquifer and thus a higher capacity.

The Great Miami River is second only in Ohio to the Mad River in its unusually high summer-flow characteristics, which of course, are due to the fact that it traverses valley train deposits throughout its length. However, at this point it leaves the wide, deep alluvial filled Deep Stage valley, which can be seen to the west, and enters to the south a narrow, youthful valley cut in bedrock. It apparently was a marginal channel along the southeast side of an Illinoian lobe of ice which extended southwest down the Deep Stage valley incised below the broad strath-like lowland on the upland along pre-glacial drainage ways (Plate II).

To the east a terrace of Wisconsin outwash (610') projects below a more dissected Illinoian terrace (680'). The low bedrock hills of the upland can be seen beyond.

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THIS ENDS THE CONDUCTED FIRST DAY OF THE FIELD CONFERENCE. Three collecting localities are given with proper directions below for those planning to stay over. The second day will not be a conducted field conference.

RETURN ROUTE INFORMATION

1. To Cincinnati - return to Miami River bridge and follow U.S. 27.
2. To Dayton, Columbus - return to Miami River bridge and follow By-pass U.S. 50 east to Mill Creek expressway (Interstate 75).
3. To Chillicothe - ditto, but continue on By-pass U.S. 50 to highway U.S. 50.

SECOND DAY.

The Cincinnati area is rich in good fossil-collecting sites. Three half-day "unescorted" field trips are outlined below. It is recommended that a copy of the excellent Elementary Guide to the FOSSILS AND STRATA OF THE ORDOVICIAN in the Vicinity of Cincinnati, Ohio, by Kenneth E. Caster, et. al., be secured.

A fourth suggested half-day trip is to the newly located Cincinnati Museum of Natural History.

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TRIP 1. CINCINNATI AREA (Western Hills)(West Cincinnati 15' quadrangle)

Cross Mill Creek valley on Hopple Street Viaduct (reached by descending Probasco Street from Clifton Avenue, opposite the Applied Arts College, to Marshall Street (left) to Central Parkway light; turn right on Parkway to next light (Hopple Street); left on Hopple Street and cross viaduct at light, Beekman Street, turn right; proceed to second housing unit on left; enter main drive and proceed as far toward hill as possible.)

Good collecting can be had on the slopes in the Eden Group. (Graptolites and nodules containing fine inflated graptolites (for acid treatment).

Return to Hopple Street light, and turn right up Westwood-Northern Boulevard. Excellent collecting in various units of the Maysville along

the boulevard; at top of first grade, in front of white Catholic church: Bellevue (edrio-asteroids on Rafinesquina shells); Fairmount at the first street intersection (stop sign); proceed to end of boulevard onto Harrison Ave. and stop at great highway fill just before entering Dent. Down the hill to the right to old stripped surface: splendid fossil-collecting in the lower Richmond and upper Mt. Auburn. Famous crinoid site, splendid brachiopods and bryozoans.

TRIP 2. STONELICK CREEK, EAST OF CINCINNATI, CLERMONT COUNTY (East Cincinnati and Batavia)(15' quadrangle)

Via Wm. Howard Taft Road (called Calhoun on south edge of U.C. campus), east on Taft Road to its end on Columbia Parkway, left on Parkway to end and follow Route 50 on through Mariemont and Milford. Out of Milford continue on Route 50 to Junction Ohio 131, left on Ohio 131 to crossing of Stonelick Creek (about 9.8 miles). With care you may drive down to the creek, just after crossing the iron bridge (watch for high middle and rocks!). Creek floor here in the richly fossiliferous Corryville. Mt. Auburn upstream, Bellvue about a mile downstream. This is the richest fossil hunting ground in the vicinity of Cincinnati. Many rarities are found in this section, plus excellent trilobites, crinoids and problematica. Time permitting, one may descend the creek into Eden (several miles) with an almost continuous section - fossiliferous all the way.

TRIP 3. FT. ANCIENT AREA (East Cincinnati, Batavia and Morrow)(15' quadrangle)

Leave Cincinnati by Wm. Howard Taft Road (called Calhoun on south edge of U.C. campus) to Gilbert Avenue (Ohio 22), left (north) on Ohio 22 (farther north name changes to Montgomery Road). Continue over Fosters, Ohio and the Little Miami River on high viaduct. Just beyond this, park in the Roadside Park. Good Maysville collecting in creek-bed, and along this same creek up the grade for next half-mile.

Continue on Route 22 through Morrow to Rochester, turn right on Ohio 123, south. Cross Todd Fork (about 1.7 miles) - good upper Maysville collecting just south of the bridge. Continue on Ohio 123, turn left (northeast) and stop at Lick Run (about .5 miles). Splendid Mt. Auburn Section, rich in "double-headed dutchmen" (Platystrophia ponderosa) and many other fine fossils. Continue on Ohio 132 to Middleboro. In Middleboro, turn left on main cross-roads (Middleboro-Blanchester Road) and stop at first creek crossing. Fine Waynesville collecting in creek to the left, on descent toward Todd Fork.

Now two choices: Either return to Middleboro (A. below) or continue on Middleboro-Blanchester Road (B. below):

A. Return to Middleboro and turn left, following Ohio 132 into Clarksville. About .25 miles after crossing Ohio 350 in Clarksville, and at first creek of some size (Sewell Run) stop and hike up creek. This is often a whole day's collecting trip alone, such is the excellence of the Richmond section and fossil-hunting on the Run. The late Carrie Williams of Clarksville made very rich "hauls" here. Continue on along the same main road (old Ohio 3 and 22) approximately 1.5 miles to Cowan Run. Excellent Richmond collecting up Cowan Run. (Again, could easily be a whole day's excursion).

B. Continue on Middleboro-Blanchester Road ... Cross Todd Fork and Ohio 3 and 22 and past the first country cross-road to a Y fork, just across Stony Creek. Park and descend the creek. Splendid Waynesville collecting - one of the famous "butter-layer" trilobite sites. Many other fossils. Mt. Auburn beds exposed about 1.5 miles down creek, near junction with Todd Fork. Continue on to Ohio 350 and turn left (west) to Ft. Ancient Park (mound builder fortified site). Museum on Todd Fork below.

TRIP 4. THE CINCINNATI MUSEUM OF NATURAL HISTORY

Drive east on Wm. Howard Taft (Calhoun Street south of U.C. campus) to Gilbert Avenue. Turn right (south) on Gilbert to Cincinnati Museum of Natural History at Elsinore Avenue. Turn left through arch to parking area behind museum, which is open from 1:00 to 5:00 P.M. Sundays.

The Cincinnati Museum of Natural History was started in 1870 by Charles Dury, former secretary of the Ohio Academy of Science, as the Cincinnati Society of Natural History - a direct outgrowth of the Western Academy of Science, founded in 1835. It is the oldest museum of its kind West of the Allegheny Mountains. Having evolved to maturity in makeshift quarters under Ralph Dury, son of the founder, it migrated two years ago to its own shell, a specially designed structure firmly rooted to Upper Ordovician shale in Eden Park. The handsome building was erected entirely by public subscription in response to an appeal to its city-wide membership, without drawing on state or municipal funds. Almost before the cement had hardened, the new wave of interest - proved by a yearly attendance of one million - forced the Board of Directors to embark on a program of expansion. The storage space is already overcrowded and technicians are working overtime to ready new exhibits; to prepare over one thousand portable loan displays for the city schools, and material for lectures at high-school assemblies and formal presentations in the museum lecture hall. The new planetarium will be open in October.

Meanwhile, the versatility of the layout allows constant shifting of the elements in the panaorama which gives a freshness of impact not found in conventional museums and which suggests Science on the Move. Among the exhibits you will find most striking are those of marine life in the Cincinnatian Period, Early Man in Ohio, Lower Paleozoic Fossils, with Animal, Vegetable and Mineral collections from Ohio and the peripheral world. A visit to the Cincinnati Museum of Natural History will serve as a model to suggest ways in which something of the kind may be developed in your own home community.

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OAS 4-22-6' STOP 5

RACK SAND &
Este Ave
Cincinnati
Durrell